

# THE IMPACT OF QUALITY OF LIFE MEASURES ON THE DECISION TO HAVE THIRD MOLARS REMOVED IN SUBJECTS WITH MILD PERICORONITIS SYMPTOMS

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## **ABSTRACT**

Dana T. Tang: The Impact of Quality of Life Measures on the Decision to have Third Molars Removed in Subjects with Mild Pericoronitis Symptoms  
(Under the direction of Raymond P. White Jr.)

**Subjects and Methods:** Healthy subjects (N=113) with mild pericoronitis signs/symptoms were enrolled in an IRB-approved study. Demographic and quality of life (QoL) data were collected at enrollment. Subjects voluntarily scheduled for third molar removal (3MR). The outcome variable was subjects' decision for 3MR within six months of enrollment. Possible predictor variables were demographic and QoL data. To explore associations between the predictor and outcome variables, bivariate analyses (Chi-square and Cochran-Mantel-Haenszel) and a multivariate logistic regression were performed.

**Results:** At six months post-enrollment, 79 subjects elected 3MR (removed) and 34 subjects retained their third molars (retained). A greater proportion of the removed compared to the retained group reported at least "a little trouble" with opening their mouths, 38% vs. 18%, respectively ( $P=0.04$ ), and taking part in social interactions, 27% vs. 6%, respectively ( $P=0.01$ ).

**Conclusion:** In pericoronitis subjects, problems with oral function and lifestyle were associated with subjects' decision for early 3MR.

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## **CHAPTER 1: LITERATURE REVIEW**

### **Introduction**

In the United States, most young adults and adolescents have at least one third molar and will likely face the decision as a young adult of whether or not to have their third molars removed.<sup>1</sup> As clinicians, it is important to have current data to counsel patients about third molar management and to assist them in their decision making. About three-quarters of third molars will develop pathology, including caries and periodontal inflammatory disease.<sup>2-5</sup> The most commonly reported third molar problem is symptomatic periodontal inflammatory disease, most often termed pericoronitis.<sup>6</sup> Furthermore, pericoronitis is a commonly cited reason for third molar removal.<sup>7</sup>

Pericoronitis has been shown to be an indicator of more severe periodontal inflammatory disease and to have adverse effects on quality of life.<sup>8,9</sup> Removal of affected third molars can improve overall periodontal health status and outcomes on quality of life.<sup>10-12</sup> A review of the literature suggests the prevalence of pericoronitis to be between 1.9% and 8%.<sup>13-15</sup> Most but not all individuals with a symptomatic or diseased third molar will elect removal.<sup>16, 17</sup> The decision for third molar removal can be influenced by several factors, including the patient's age, symptoms, presence of disease, and treatment recommendation.<sup>16, 17</sup>

### **Definition and Etiology**

Pericoronitis is an inflammatory response affecting the soft tissue that surrounds a partially erupted or erupted tooth.<sup>9, 18</sup> The condition often involves a single mandibular third

molar with a wide range of signs and symptoms, including pain, swelling, and purulence, or more severe signs and symptoms, such as trismus, dysphagia, enlarged regional lymph nodes, and fever.<sup>18</sup> Although pericoronitis can be bilateral, it usually occurs unilaterally.<sup>18</sup> An acute pericoronitis episode may last only a few days, but recurrences typically follow a remission period of 7 to 15 months.<sup>18</sup>

The symptomatic condition of pericoronitis may occur when there is mucoperiosteum that overlies a third molar, creating a crevice where food and debris can easily accumulate.<sup>19</sup> More commonly, symptoms result from an inflammatory response to anaerobic pathogens colonized in deeper periodontal probing sites around third molars.<sup>20-22</sup> Once a third molar erupts, its surface is exposed to the oral cavity.<sup>20</sup> Exposed tooth surfaces are accessible to the oral environment from the occlusal surface inferiorly to the gingival attachment.<sup>20</sup> Clinically, periodontal probing depths (PDs) of 4mm or more ( $PDs \geq 4mm$ ) are common around mandibular third molars.<sup>23, 24</sup> These increased periodontal probing depths reflect an increase in the surface area of the biofilm-gingival interface (BGI) which accompany anaerobic conditions favorable to the colonization of periodontal pathogens.<sup>20, 22, 25</sup> Bacteria colonize on all accessible tooth surfaces in a non-sheddable biofilm.<sup>22</sup>

Early colonizers include elevated microbial counts for primarily anaerobic microorganisms, such as *Selenomonas noxia* and the “orange” complex bacteria, *Bacteroides gracilis*, *Fusobacterium nucleatum* ss *vincentii*, *Peptostreptococcus micros*, *Prevotella intermedia*, and *Prevotella nigrescens*.<sup>21, 26, 27</sup> Socransky *et al*’s data suggest that over time, the “red” complex of bacteria, *Porphyromonas gingivalis*, *Tannerella forsythia*, and *Treponema denticola* colonize the area.<sup>21</sup> One report by Rajasuo *et al* has documented the colonization of *Porphyromonas gingivalis* and *Tannerella forsythia* in samples taken from pericoronitis

patients.<sup>28</sup> These “orange and red” complex microorganisms are considered risk factors for periodontal inflammatory disease.<sup>21</sup>

Virulence factors from these bacteria elicit a local immune response, which consequently results in periodontal inflammatory disease.<sup>20-22</sup> Individuals who have mild signs and symptoms of pericoronitis have elevated levels of inflammatory mediators such as the cytokines interleukin-1 beta in their gingival crevicular fluid (GCF IL-1 $\beta$ ).<sup>26</sup> These are indicators of the immune response to pathogens in the affected region of the mouth.<sup>26</sup> Removal of the symptomatic third molars results in a reduction of the microbial burden, but GCF IL-1 $\beta$  levels may remain elevated, suggesting an immune system memory persisting for an undetermined time.<sup>26</sup> Reports in the literature also add emphasis to the nature of the inflammatory response to pathogens.<sup>29</sup> For example, Laine *et al* assessed the degree of inflammation in the gingival mucosa and dental follicles of patients with pericoronitis.<sup>29</sup> Compared to healthy patients without third molar symptoms, the inflamed tissue involved in pericoronitis had increased counts of macrophages in the tissue samples, which characterize the chronic nature of pericoronitis.<sup>29</sup>

In terms of the overall periodontal status of patients, Gelesko *et al* found that for patients with symptomatic third molars, their overall periodontal status was more compromised than for patients with asymptomatic third molars.<sup>8</sup> Aside from the periodontal status in the third molar region, defined by the six probing sites on the third molars and the two distal probing sites on the second molars, the median number of PDs  $\geq$  4mm for all teeth was higher for patients with pericoronitis than without pericoronitis.<sup>8</sup>

## **Epidemiology**

The true prevalence of pericoronitis among geographic regions and population groups is unknown. Some data come from studies of military recruits.<sup>13-15</sup> Leone and Edenfield evaluated

359 United States military recruits with a mean age of 19.9 years, and reported the prevalence of pericoronitis to be 1.9%.<sup>13</sup> In a study of 876 Finnish military recruits also with a mean age of 19.9 years, the prevalence of pericoronitis was estimated to be 6%.<sup>15</sup> Furthermore, a survey of Norwegian general dentists suggested the prevalence of pericoronitis be slightly over 8% for one year extrapolated from reports of third molar symptoms during a one month period.<sup>14</sup> With the improvement in dental care and oral health awareness among many populations, it has been speculated that the decrease in loss of teeth more anterior to third molars may result in a rise in pericoronitis.<sup>18, 30</sup>

Kay's study on 2,340 patients with pericoronitis identified 16 to 30 years as the most susceptible age group for pericoronitis, with the maximum reports found in the ages of 21-25 years.<sup>18</sup> There is no significant predilection of pericoronitis for the female or male gender.<sup>18</sup> Peaks of incidence have been reported to occur in the spring and autumn, possibly due to the humidity and temperature of the environment that allow for key pathogens to colonize and multiply.<sup>18</sup> Individuals of a higher socio-economic group, perhaps due to higher dental educational knowledge and less loss of first and/or second mandibular molars, are more prone to experience a pericoronitis attack than individuals of a lower socio-economic group.<sup>18</sup> Recurrences of pericoronitis are not rare.<sup>13, 18, 31</sup> Kay reported in his comprehensive study of subjects with pericoronitis that acute symptoms can occur 2 to 27 months following the last episode, with most recurrences occurring within 7 to 15 months.<sup>18</sup> The risk for an early recurrence may be increased if an impinging upper tooth is present.<sup>18</sup> Leone and Edenfield's evaluation of United States naval recruits found that 71% of patients with pericoronitis reported similar problems with the same tooth in the past.<sup>13</sup> Ventä *et al* evaluated the history of patients who reported with symptomatic third molars and found that 51% of these patients had at least

one previous episode with the same tooth, 36% had two or more episodes with the same tooth, and 62% had symptoms with another third molar.<sup>31</sup>

### **Risk Factors**

There are many factors that can increase the risk of pericoronitis.<sup>18, 19, 26, 32-35</sup> An opposing maxillary molar may exacerbate the development of pericoronitis.<sup>18, 19</sup> For example, in a situation where there is already inflammation around the mandibular third molar, local trauma caused by the opposing third molar can intensify the inflammation.<sup>18, 19</sup> Although an opposing maxillary molar can play a role in pericoronitis, Halverson and Anderson found that the absence of a maxillary molar or impinging tooth does not eliminate the risk of pericoronitis.<sup>32</sup>

As more studies characterize third molars and pericoronitis, a better understanding of individuals with molars at high risk for developing pericoronitis have emerged.<sup>18, 26, 32-34</sup> Leone *et al* reported that the mandibular molars at highest risk for pericoronitis are characterized by vertical angulation, the crown at or above the occlusal plane, partial coverage by either soft or hard tissue, and teeth that are fully erupted.<sup>33</sup> Blakey *et al*, Halverson *et al*, and Wallace also reported that pericoronitis usually involved vertically erupted third molars at or above the occlusal plane.<sup>26, 32, 34</sup> On the contrary, Kay reported that of all third molar positions in his study of pericoronitis patients, mesioangular (34.4%) was the most common, followed by distoangular (30.6%), vertical (28.2%), horizontal (6.6%), and linguoversion (0.2%).<sup>18</sup> Leone *et al* proposed that the conflicting results may be explained by the fact that in his own study, little difference in angulation existed between distoangular molars and vertically positioned third molars.<sup>33</sup>

Upper respiratory tract infections, emotional stress, pregnancy, fatigue, and previous or current illnesses are also associated with pericoronitis.<sup>18, 19, 35</sup> These factors are thought to alter the immune system and the inflammatory response to pathogens.<sup>19, 35</sup>

## **Treatment**

Currently, the only effective treatment for pericoronitis is the removal of the symptomatic tooth.<sup>12, 26</sup> As previously explained, once a third molar erupts and can be probed, key pathogens can colonize and establish on the tooth surface.<sup>20-22</sup> In areas of the non-sheddable biofilm on the third molars, bacteria cannot be completely eliminated unless the tooth is removed.<sup>12, 26</sup> Once the symptomatic third molar is removed, there is a reduction in the surface area of the biofilm-gingival interface. This alters the environment for the pathogens. Dicus-Brookes *et al* showed that the removal of the symptomatic third molar also improves the overall periodontal status of the remaining dentition.<sup>10</sup> The median number of PDs  $\geq 4$ mm and the extent, or percentage of PDs  $\geq 4$ mm for all probing sites, for the distal of the second molars and the remainder of the dentition, were reduced substantially from pre-surgery to post-surgery.<sup>10</sup>

In acute cases of pericoronitis, a regimen of antibiotics and analgesics may be initiated as temporary measures to decrease symptoms prior to the removal of the third molar.<sup>36</sup>

Debridement of the biofilm and irrigation of the affected anatomic area can facilitate temporary relief, reducing pain and levels of host inflammatory factors.<sup>26</sup> The microbial counts will remain high because mechanical debridement is ineffective.<sup>26, 37</sup> Fisher *et al* assessed the effectiveness of mechanical debridement of the subgingival biofilm in patients with retained third molars.<sup>37</sup> At a median follow-up time of 2.2 years, they found no significant differences in periodontal pocket depths from time at enrollment to follow-up.<sup>37</sup>

## **Risks for Retaining Symptomatic Third Molars**

What are the risks for retaining symptomatic third molars? To date, there are no published longitudinal studies for pericoronitis documenting the risks, possibly due to the fact that many patients affected with pericoronitis eventually decide to have the affected tooth

removed.<sup>17</sup> With the understanding of the etiology of periodontal inflammatory disease, however, one can speculate from longitudinal studies with asymptomatic third molars what may happen to patients with symptomatic third molars over time.<sup>8, 23, 24, 38</sup> Blakey *et al* reported that in cases of asymptomatic third molars with a median follow-up of 2.2 years, periodontal pathology in the third molar region worsens, measured by changes in PDs  $\geq 2$ mm.<sup>23</sup> They also showed that with a median follow-up time of 5.9 years, periodontal pathology worsens for the remainder of the mouth, not just the third molar region.<sup>24</sup> As previously mentioned, Gelesko *et al* showed that pericoronitis may reflect more severe underlying periodontal disease.<sup>8</sup> And for patients who present with third molars at baseline having at least one PD  $\geq 4$ mm compared to those who had no PDs  $\geq 4$ mm, White *et al* showed the odds for finding at least four PDs  $\geq 4$ mm in the third molar region increased 12-fold and the odds for finding at least one PD  $\geq 4$ mm in the nonthird molar region increased nearly 5-fold.<sup>38</sup> Therefore, it can be inferred that if symptomatic third molars are retained, the periodontal statuses of the third molar and nonthird molar regions will worsen over time.

### **Quality of Life – Definition and its Importance**

The World Health Organization (WHO) defines *Quality of life* as “an individual’s perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns.”<sup>39</sup> Naturally, one may assume that an individual’s environment, level of independence, and social relationships affect an individual’s quality of life, but the WHO states that an individual’s physical health and psychological health also affect quality of life.<sup>39</sup> An injury, disease, or medical treatment can impact a patient’s life.<sup>40</sup> *Health-related quality of life* as defined by Gift and Atchison addresses the balance between how long and how well people live, taking into account individuals’

functional states, impairments, perceptions, and social opportunities, which can be influenced by their health.<sup>40</sup>

Health was traditionally viewed as the absence of disease.<sup>41</sup> In the previous centuries, there were epidemics of acute and infectious diseases.<sup>40</sup> With the advancement in medicine, the mortality associated with these diseases have decreased.<sup>40, 41</sup> The focus of health care has shifted to emphasize the chronic diseases of today.<sup>40, 41</sup> Though there may be no cures for many of these chronic diseases, researchers and doctors continue to search for ways to improve the quality of life for those affected with chronic diseases.<sup>42</sup> Recently, health care has put more emphasis on the importance of quality of life, not just morbidity and mortality.<sup>41, 42</sup> Decisions about research, public policy, and treatment are now affected at least partially by quality of life considerations.<sup>41, 42</sup> The U.S. Department of Health and Human Services emphasized in the *Healthy people 2020* that one of their main overarching goals is to improve one's quality of life.<sup>43</sup>

### **Measuring Oral Health Related Quality of Life**

As health related quality of life has become more important, there have been a number of instruments created to assess the impact that certain conditions have on one's quality of life.<sup>40</sup> In oral health, two common instruments include Slade's 14-item Oral Health Impact Profile (OHIP-14), derived from the longer 49-item Oral Health Impact Profile, and McGrath *et al*'s United Kingdom Oral Health Related Quality of Life (OHQoL-UK).<sup>44-46</sup> These global instruments assess how oral conditions impact quality of life.<sup>44-46</sup> There are also specific instruments that have been developed to capture the more subtle impact of specific conditions.<sup>47</sup> For example, Shugars *et al* developed a third molar Health Related Quality of Life (HRQoL) instrument to measure patients' perceptions of their experiences with third molars.<sup>47</sup> Since the development of



these instruments, many have used them to study the impact of oral conditions, including third molar symptoms and surgery, on quality of life.<sup>9, 11, 12, 42</sup>

### **Impact of Pericoronitis and Treatment on Quality of Life**

Symptomatic pericoronitis has an impact on one's quality of life.<sup>9</sup> McNutt *et al* assessed the health related quality of life for 57 subjects with mild symptoms of pericoronitis using Shugars *et al*'s HRQoL instrument and Slade's OHIP-14.<sup>9</sup> Sixty-eight percent of the subjects reported the worst pain they experienced in the week before enrollment to be at least moderate to severe pain.<sup>9</sup> Not only did these subjects experience pain, but a significant percentage of the subjects reported problems with oral function.<sup>9</sup> Almost one-quarter of the subjects reported that they had "quite a bit/lots" of difficulty with eating and 19% had "quite a bit/lots" of difficulty with chewing.<sup>9</sup>

Removal of third molars will improve quality of life outcomes in patients with symptomatic pericoronitis.<sup>11, 12</sup> McGrath *et al* assessed the quality of life outcomes for 69 subjects with pericoronitis six months after having one mandibular third molar removed.<sup>11</sup> Using the OHIP-14 and OHQoL-UK, they found that removal allowed for a significant improvement in oral health related quality of life.<sup>11</sup> Similarly, Bradshaw *et al* evaluated 60 subjects who presented with mild symptoms of pericoronitis and elected to have all their third molars removed.<sup>12</sup> At a median of 7.7 months after surgery, significant improvements in quality of life outcomes were reported.<sup>12</sup> At enrollment, only 15% of subjects reported their pain intensity in the previous weeks as "nothing," "faint," or "very weak."<sup>12</sup> This increased to 96% at follow-up.<sup>12</sup> For oral functions, 22% of subjects reported having "quite a bit/lots" of difficulty with eating desired foods in the week prior to enrollment and this decreased to only one subject reporting this difficulty at follow-up.<sup>12</sup> Forty-two percent of subjects reported having no difficulty with

eating and this increased to 95% at follow-up.<sup>12</sup> Compared to McGrath *et al*'s findings, Bradshaw *et al* reported a greater reduction in the median OHIP severity score, 11.5 versus 5, suggesting that perhaps, having all four third molars removed could allow for greater improvements in quality of life.<sup>11, 12</sup> These findings show the positive impact that third molar extractions have on quality of life, reassuring those who are currently affected by pericoronitis.<sup>11, 12</sup>

Although studies clearly show the impact that pericoronitis has on quality of life, that removal is the only effective treatment, and that quality of life is improved with the removal of affected teeth, some individuals with third molar problems decide not to have their third molars removed.<sup>9, 11, 12, 16, 17, 26</sup> In a longitudinal study by Ventä *et al*, about one-third of subjects had third molar symptoms. Most subjects, 87%, but not all had third molar(s) removed.<sup>17</sup>

### **Factors Affecting Third Molar Decisions**

Why do some symptomatic individuals elect to have their third molars removed while others decide to retain their third molars? In the previously mentioned study by Ventä *et al*, both asymptomatic and symptomatic subjects were asked about their reasons for third molar removal or retention.<sup>17</sup> Seventy-six percent of subjects who elected extractions reported that they elected extractions because it was recommended by their dentist and over one-quarter of subjects elected extractions because they had symptoms of pain.<sup>17</sup> Kinard and Dodson looked at patients who presented for evaluations of their third molars and explored to see if there were any differences between the individuals who elected extractions versus retention.<sup>16</sup> They concluded that age, clinical assessment of third molars, and treatment recommendations were factors associated with patient's decisions.<sup>16</sup> Increased age, clinical assessment of third molars as having no disease and no symptoms, and treatment recommendations to retain third molars were associated with the

subjects' decision to retain third molars.<sup>16</sup> To date, there is no study that evaluates the factors that influence patients' decisions for third molar removal or retention in those specifically affected with pericoronitis.

Most people assume that pericoronitis only involves issues of pain and might conclude that pain is probably the only factor that prompts pericoronitis patients to have their third molars removed; but as previously mentioned, there are other quality of life measures associated with pericoronitis.<sup>9</sup> The focus of this thesis is to evaluate the factors in addition to symptoms of pain that influence the decision and timing to have third molars removed in subjects with pericoronitis. This study focused on demographic characteristics, availability of insurance, and quality of life measures as possible explanatory variables for a patient's decision to remove or retain third molars within six months after enrollment with mild pericoronitis symptoms.

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## CHAPTER 2: MANUSCRIPT

### Introduction

Pericoronitis is a chronic periodontal inflammatory condition associated with a partially or fully erupted tooth, most often a mandibular third molar.<sup>1,2</sup> This symptomatic condition is commonly diagnosed in individuals between 16 and 30 years of age and has a wide range of symptoms including pain and swelling, or the more severe clinical signs of purulence, trismus, dysphagia, enlarged lymph nodes, and fever.<sup>1</sup> Although an acute pericoronitis episode may last for only a few days, recurrences typically follow with a remission period of 7 to 15 months.<sup>1</sup> Ventä *et al* evaluated the history of patients with symptomatic third molars and found that 51% of reported patients had one previous episode with the same tooth.<sup>3</sup> The prevalence of pericoronitis has not been studied for the U.S. population. Berge has reported the only population data for pericoronitis with an approximately 9% prevalence, from a Norwegian population based on reports from general dentists.<sup>4</sup> Estimates based on available data vary, ranging from 2% to 9%.<sup>4-6</sup> Currently, the most effective treatment for pericoronitis is the removal of the symptomatic tooth.<sup>7</sup>

The most prevalent third molar symptom is pain usually associated with pericoronitis. Berge and Boe found in a random sample of 176 general dentists that pericoronitis contributed to 43% of third molar problems.<sup>8</sup> Furthermore, pericoronitis is the most commonly reported reason for third molar removal in young adults and older age groups.<sup>9</sup> For example, in a cohort of patients 35 years or older, 41% reported pericoronitis as the reason for electing to have their third molars removed, followed by periodontal problems, 25%.<sup>9</sup>



In addition to symptoms of pain, pericoronitis also has an impact on one's quality of life including lifestyle and oral function.<sup>2</sup> McNutt *et al* assessed the quality of life of 57 subjects with mild symptoms of pericoronitis and found that 68% of the subjects reported the worst pain they experienced in the week before enrollment to be at least moderate in severity.<sup>2</sup> Almost one-quarter of the subjects reported oral function problems and had "quite a bit/lots" of difficulty with eating and 19% had "quite a bit/lots" of difficulty with chewing.<sup>2</sup>

Removal of third molars improves quality of life measures in patients with pericoronitis symptoms.<sup>10, 11</sup> McGrath *et al* assessed quality of life measures in 69 subjects with pericoronitis: six months after having one mandibular third molar removed, quality of life was improved as measured by Oral Health Impact (OHIP-14) scores.<sup>10</sup> Similarly, Bradshaw *et al* evaluated 60 subjects who presented with mild symptoms of pericoronitis and elected to have all third molars removed.<sup>11</sup> At a median of 7.7 months after surgery, significant improvements in quality of life measures were reported. For example, at enrollment, 15% of subjects reported their pain intensity in the week prior to enrollment as "nothing," "faint," or "very weak." This outcome improved to 97% at follow-up. As for oral function, 42% reported having no difficulty with eating in the week prior to enrollment and this outcome increased to 95% at follow-up.

Although studies clearly show that pericoronitis negatively impacts quality of life and that removal of affected teeth can improve quality of life, not everyone with these third molar problems elects to have their third molars removed.<sup>12, 13</sup> In a longitudinal study by Ventä *et al*, a third of subjects had third molar symptoms. Most subjects with symptoms, 87%, but not all had third molars removed.<sup>13</sup>

The question remains: What factors in addition to symptoms of pain influence the decision to have third molars removed in subjects with pericoronitis? This study focused on

demographic characteristics, availability of dental insurance, and quality of life measures as possible explanatory variables for a patient's decision to remove or retain third molars within six months after enrollment with mild pericoronitis symptoms.

## **Subjects and Methods**

Subjects were enrolled in a study designed to better understand the clinical signs and symptoms of mild pericoronitis affecting mandibular third molars as they relate to oral and systemic inflammation. The subjects were recruited at a single academic clinical center, the University of North Carolina, for an institutional review board-approved, prospective, exploratory clinical study. All data from subjects enrolled between 2006 and 2012 with information about whether third molars had been removed or retained at six months post-enrollment were included in the analyses. Subjects having third molars removed were seen for follow-up at least three months after surgery.<sup>11</sup> All subjects who did not have third molars removed were followed for at least a year after enrollment.

Inclusion criteria for the study specified that subjects be aged 18 to 35 years, have a health risk assessment level I or II according to the American Society of Anesthesiologists' classification, and have mild signs or symptoms of pericoronitis, including spontaneous pain, purulence or drainage, or localized swelling, affecting at least one mandibular third molar. Subjects with severe signs or symptoms of pericoronitis, such as limited mouth opening, dysphagia, having a temperature greater than 101°F, facial swelling/cellulitis, or severe uncontrolled discomfort were excluded. Additionally, those with a medical condition contraindicating periodontal probing, an acute illness, a body mass index greater than 29 kg/m<sup>2</sup>, a history of taking antibiotic treatment within the past two months, generalized periodontal

disease (Class IV according to the American Academy of Periodontology index), and tobacco use were excluded.

Once consent to participate in this study was obtained, demographic, clinical, and quality of life data were collected from each subject. In order to assess the impact of mild pericoronitis on quality of life in the previous week, subjects at enrollment were asked to complete the Health Related Quality of Life (HRQoL) instrument which included two items in the Pain domain and four each in the domains of Lifestyle and Oral Function, developed by Shugars *et al* specifically for third molar problems.<sup>14</sup> Subjects were asked to report how oral function and lifestyle were affected in the week prior to enrollment using 5-point Likert-type scales, ranging from “no trouble” (score 1) to “lots of trouble” (score 5). Since pain is the predominantly reported symptom of pericoronitis, subjects were asked to assess pain in the week prior to enrollment using a 7-point Likert-type scale. The 7-point scale for pain extended from “*no pain*” (score 1) to “*worst pain imaginable*” (score 7).

Items were categorized according to content into specific domains: oral function, lifestyle, and pain. Pain items were worst and average pain. The thresholds of pain severity were reported as “*no pain*” (score 1), “*little/moderate pain*” (scores 2 to 4), and “*severe pain*” (scores 5 to 7). Oral function deals specifically with the ability to eat, chew, talk, and open one’s mouth. Lifestyle includes the ability to sleep, carry out a daily routine, take part in a social life, and participate in sports or hobbies. For analyses, the thresholds of oral function and lifestyle impact were “*no trouble*” (score 1), “*a little trouble*” (score 2), and “*more than ‘a little trouble’*” (scores 3 to 5), which consists of the responses, “*some,*” “*quite a bit,*” and “*lots of trouble.*”

Gross debris was removed from the symptomatic third molar(s) at enrollment and analgesic medications were prescribed as needed for pain. Subjects were given the

recommendation that third molar(s) should be removed as the most predictable treatment for the condition, but no timetable for surgery was prescribed. Subjects voluntarily scheduled the surgery in consultation with their dentist.

Based on the report from Bradshaw *et al* which assessed quality of life outcomes after surgery in subjects with mild pericoronitis, subjects were divided into two groups based on whether surgery was elected within six months of enrollment (removed) or third molars were retained at six months post-enrollment (retained).<sup>11</sup> The principal outcome variable for analyses in this study was the decision to have or not have surgery within six months of enrollment. The principal predictors or explanatory variables were the subjects' reported quality of life in the domains of oral function, lifestyle, and pain at enrollment. Other possible contributing variables were demographics (age, gender, ethnicity, and highest educational level) and the availability of dental insurance that at least partially would contribute to covering the charges for the surgery.

Data entry and data management protocols were used as described earlier by White *et al*.<sup>15</sup> For the subjects in the removed and retained categories, demographic characteristics and availability of insurance were compared using Chi-square analyses. Quality of life measures were compared using Cochran-Mantel-Haenszel row mean score statistics. Logistic regression using a two step forward selection approach was used to identify quality of life variables that contributed to the subject's decision. The first model included only the demographic and availability of dental insurance variables. Statistically significant variables from the first model were forced in the second forward selection model that included the quality of life measures. The analyses were done using SAS 9.2 (SAS Institute, Cary, NC). Significance was set at  $P < 0.05$  for all analyses.

## Results

A total of 113 subjects with mild symptoms of pericoronitis were enrolled over a six year period from 2006 to 2012. Most subjects eventually elected third molar removal; only a few subjects retained third molars for the entire study period, which amounted to at least a year (Figure 1). The mean age of subjects at enrollment was 23.2 years (standard deviation [SD]  $\pm 3.8$  years). More subjects were female and Caucasian, 56% and 51%, respectively (Table 1). Also, most subjects were well educated; 92% reported having at least some college education. Fewer than half of all subjects, 41%, had dental insurance.

Subjects in the removed category were more likely to be 23 years old or younger as compared to older, but this pattern was not statistically significant,  $P=0.11$ . The mean age of the 79 subjects at enrollment in the removed group was 22.8 years (SD  $\pm 3.5$  years) and the mean age of the 34 subjects at enrollment in the retained group was 23.9 years (SD  $\pm 4.2$  years). Differences in ethnicity existed between the two groups; significantly more subjects having surgery within six months of enrollment were Caucasian as compared to those delaying surgery later than six months or retaining their third molars, 58% and 35%, respectively ( $P=0.03$ ). Additionally, more African Americans were in the retained group, 35%, as compared to the removed group, 18%. While only 41% of the total subjects had dental insurance, more subjects in the removed group reported having dental insurance, 47%, as compared to the retained group, 29% ( $P=0.09$ , Table 1).

Seventy-nine subjects elected third molar removal within six months of enrollment with a mean time of 2.5 months (SD  $\pm 1.6$  months) post-enrollment (Figure 1). Thirty-four subjects retained their third molars at six months post-enrollment; 14 of these subjects eventually had their third molars removed, nine of these had their third molars removed greater than one year

post-enrollment. Half of the 34 subjects who retained their third molars at six months post-enrollment, which is 15% of the total 113 subjects enrolled, retained their third molars at the last follow-up, at least a year after enrollment.

Quality of life measures in the oral function domain tended to be higher in the week prior to enrollment for the removed group compared to the retained group. Significantly more subjects in the removed group, 38%, had at least “a little trouble” with mouth opening as compared to subjects in the retained group, 18% ( $P=0.04$ , Figure 2, Table 2). Although not statistically significant, a greater proportion of subjects in the removed group also reported higher scores or “more than ‘a little trouble,’ ” for other oral function items as compared to the retained group (Figure 2, Table 2). For example, 38% of subjects in the removed group reported “more than ‘a little trouble’ ” with chewing as compared to 33% in the retained group.

In the lifestyle domain, significantly more subjects in the removed group, 27%, had at least “a little trouble ” taking part in a social life as compared to subjects in the retained group, 6% ( $P=0.01$ , Figure 3, Table 2). Interestingly, the difficulty with opening and the effect on social interactions were significantly correlated ( $r_s = 0.49$ ;  $P < 0.0001$ ). In comparison to the oral function items, the proportion of subjects in both the removed and retained groups who reported at least “a little trouble” in the lifestyle items tended to be smaller. However, more subjects in the removed group reported at least “a little trouble” in all of the lifestyle measures, as compared to the retained groups.

The mean scores for worst and for average pain in the week prior to enrollment were on the lower end of the 7-point Likert-type scale, compatible with the enrollment criteria for the study. The mean worst and average pain levels were not significantly different for the removed group compared to the retained group,  $P= 0.30$  and  $0.59$ , respectively (Data not displayed). More

subjects did report worst pain levels in the week prior to enrollment as *severe* in the removed group, 27%, as compared to the retained group, 15% ( $P=0.23$ , Figure 4, Table 2). Few subjects in both groups reported average pain as *severe*.

The multivariate logistic regression models suggested two factors that increased the odds of early surgery: ethnicity and an item in the lifestyle domain, the amount of difficulty the subjects had with interactions in their social life. Both were associated with the subjects' decision to have third molars removed within six months of enrollment. Caucasians were more likely to have third molars removed within six months of enrollment as compared to non-Caucasians (odds ratio [OR], 2.69; 95% confidence Interval [CI], 1.14-6.32). Having at least “a little trouble” with taking part in a social life at enrollment as compared to “no trouble” increased the chances of a decision for early surgery (OR, 3.22; 95% CI, 1.08-9.58). Those subjects with “more than ‘a little trouble’ ” with taking part in a social life as compared to “no trouble” were 10.33 ([OR], 95% CI, 1.16-91.86) times more likely to have had their third molars removed within six months.

## **Discussion**

The data we report suggest that for subjects with symptomatic third molars and pain scores on the lower end of a 7-point Likert-type scale, factors other than pain also influence an individual's decision for early surgery. On average, our study subjects who elected surgery did so less than three months after enrollment. Quality of life measures for the oral function and lifestyle domains were significantly associated with the decision for early third molar removal as compared to later removal or third molar retention. Although 15% of the 113 enrolled subjects retained third molars at the longest follow-up, the odds of electing early surgery were three times

greater for those whose lifestyle was compromised with at least “a little trouble” as compared to subjects who reported no such problems.

Quality of life issues were not the only factors associated with the decision for early surgery. Odds were over two and a half times more likely that Caucasians would elect early surgery as compared to other enrolled ethnic groups. We have no data to explain these differences. While fewer than half the subjects had dental insurance that may have reduced some of the costs of surgery, those with dental insurance tended to elect to have their third molars removed early. This suggests that financial assistance with the charges for surgery may play a role in the decision for third molar removal.

Although we report that additional factors may be influential, most clinicians will assume correctly that pain resulting from localized inflammation is a major factor involved in third molar decisions. All subjects who had third molars removed reported pain as the primary but not the sole reason for electing surgery. Clinicians readily associate pericoronitis with recurring painful episodes. Ventä *et al* evaluated the history of patients who presented with symptomatic third molars and found that half had one previous episode with the same tooth, more than a third had two or more episodes with the same tooth, and about two-thirds had symptoms with another third molar.<sup>3</sup> Furthermore, White *et al* evaluated the recovery after third molar surgery and found that previous symptoms of pain or swelling played a role in the decision for surgery in 37% of subjects.<sup>15</sup> Seventy-eight percent reported that they elected surgery to avoid future problems.<sup>15</sup>

Our definition of “early” versus “late” surgery was based on the report of Bradshaw *et al* in which subjects averaged less than three months from enrollment to surgery.<sup>11</sup> A doubling of this time period as the threshold for early surgery was somewhat arbitrary, but gave individuals sufficient time to elect surgery taking into account daily demands such as vacations, holidays,



and examinations. For the removed group, the average time to surgery was 2.5 months. It is important to add that 82% of the subjects with mild symptoms of pericoronitis who enrolled in this study eventually had their third molars removed; 8% had surgery greater than one year after enrollment.

Most subjects in our study elected surgery relatively quickly after enrollment. Blakey *et al* reported that for subjects with asymptomatic third molars, the median time from enrollment to surgery was 2.4 years.<sup>16</sup> This is twelve times longer than the two and a half month time frame for the “early” group of subjects in our study.

There are limitations to our study. Our sample consisted of young, well-educated individuals, typical of patients frequenting an academic center in a university community and not representative of the United States population who may have this condition. Our study excluded subjects with severe symptoms of pericoronitis because these individuals could not ethically be asked to retain third molars in a longitudinal study without active treatment. The inflammatory response to pathogens may differ for those with more severe symptoms of pericoronitis; more severe pericoronitis symptoms could have a greater impact on quality of life and the resulting decision and timing for third molar removal in affected individuals.<sup>17</sup> Our study excluded subjects with medical conditions contraindicating periodontal probing, antibiotic use, or generalized periodontal disease. In addition subjects with a BMI greater than 29 kg/m<sup>2</sup> or tobacco use were excluded based on the possible circulating inflammatory mediators from these conditions affecting the oral inflammatory response.<sup>18, 19</sup>

While the number of subjects in our study was adequate to demonstrate differences based on the decision for early or late surgery, the small numbers of subjects affected with lifestyle/oral function Likert scores of 3 to 5 out of 5 limited conclusions based on statistical analyses and the

generalizability to other populations. Future studies to provide data more representative of the entire US population should include a larger number of subjects and those who might not be as healthy. However, interested clinical investigators should be cautioned that overall less than 10% of young adults may have pericoronitis symptoms, making enrollment of adequate numbers of subjects protracted.<sup>4-6</sup> This outcome is reflected in the six year time frame required to enroll our subjects for this study.

How might clinicians use this data? Clinicians should not assume that only pain symptoms are important to a patient's decision for surgical removal of symptomatic third molars. Additional information on how quality of life might be affected should be documented. Making patients aware of the recurring nature of pain as well as other quality of life issues should be a part of the consultation process for a patient and the information shared with referring clinicians. Furthermore, considerations of how pericoronitis affects quality of life should lead to alterations in practice guidelines for the management of third molars.

## Tables

Table 1. Demographic characteristics of all subjects at enrollment, those who had their third molars removed within six months of enrollment (Removed), and those who retained their third molars at six months post-enrollment (Retained).

	Total (N=113) n % <sup>#</sup>		Third Molars Removed (n=79) n % <sup>#</sup>		Third Molars Retained (n=34) n % <sup>#</sup>		P value <sup>†</sup>
<b>Age (years)</b>							
≤23	66	58.4	50	63.2	16	47.1	0.11
>23	47	41.6	29	36.7	18	52.9	
<b>Gender</b>							
Female	63	55.8	43	54.4	20	58.8	0.67
Male	50	44.3	36	45.6	14	41.2	
<b>Ethnicity</b>							
Caucasian	58	51.3	46	58.2	12	35.3	0.03*
Non-Caucasian	55	48.7	33	41.8	22	64.7	
African American	26	23.0	14	17.7	12	35.3	
Asian	14	12.4	9	11.4	5	14.7	
Hispanic	6	5.3	6	7.6	0	0.0	
Other	9	8.0	4	5.1	5	14.7	
<b>Dental insurance<sup>x</sup></b>							
No	65	58.6	41	53.3	24	70.6	0.09
Yes	46	41.4	36	46.8	10	29.4	

<sup>#</sup>Column percentages reported. Percentage totals may not add up to 100% because percentages were rounded to the nearest tenth decimal place.

<sup>x</sup>Data missing for one or more subjects.

<sup>†</sup>P values based on  $\chi^2$  test, \*Significant at P<0.05.

Table 2. Quality of life measures in the week prior to enrollment for all subjects, those who had their third molars removed within six months of enrollment (Removed), and those who retained their third molars at six months post-enrollment (Retained).

Quality of Life Measure	Total (N=113) n % <sup>#</sup>		Third Molars Removed (n=79) n % <sup>#</sup>		Third Molars Retained (n=34) n % <sup>#</sup>		P value <sup>†</sup>
<b>Trouble with eating</b>							
No trouble (score 1)	45	39.8	32	40.5	13	38.2	0.94
A little trouble (score 2)	24	21.2	16	20.3	8	23.5	
More than 'a little trouble' (scores 3-5)	44	38.9	31	39.2	13	38.2	
<b>Trouble with chewing<sup>x</sup></b>							
No trouble (score 1)	41	36.6	29	36.7	12	36.4	0.81
A little trouble (score 2)	30	26.8	20	25.3	10	30.3	
More than 'a little trouble' (scores 3-5)	41	36.6	30	38.0	11	33.3	
<b>Trouble with talking<sup>x</sup></b>							
No trouble (score 1)	94	83.9	63	79.8	31	93.9	0.07
A little trouble (score 2)	15	13.4	14	17.7	1	3.0	
More than 'a little trouble' (scores 3-5)	3	2.7	2	2.5	1	3.0	
<b>Trouble with opening</b>							
No trouble (score 1)	77	68.1	49	62.0	28	82.4	0.04*
A little trouble (score 2)	24	21.2	20	25.3	4	11.8	
More than 'a little trouble' (scores 3-5)	12	10.6	10	12.7	2	5.9	
<b>Trouble with sleeping<sup>x</sup></b>							
No trouble (score 1)	79	70.5	55	70.5	24	70.6	0.87
A little trouble (score 2)	19	17.0	12	15.4	7	20.6	
More than 'a little trouble' (scores 3-5)	14	12.5	11	14.1	3	8.8	
<b>Trouble with going about daily routine</b>							
No trouble (score 1)	77	68.1	51	64.6	26	76.5	0.15
A little trouble (score 2)	24	21.2	17	21.5	7	20.6	
More than 'a little trouble' (scores 3-5)	12	10.6	11	13.9	1	2.9	
<b>Trouble with taking part in a social life</b>							
No trouble (score 1)	90	79.7	58	73.4	32	94.1	0.01*
A little trouble (score 2)	14	12.4	13	16.5	1	2.9	
More than 'a little trouble' (scores 3-5)	9	8.0	8	10.1	1	2.9	
<b>Trouble with participating in sports<sup>x</sup></b>							
No trouble (score 1)	97	86.6	67	85.9	30	88.2	0.76
A little trouble (score 2)	9	8.0	7	9.0	2	5.9	
More than 'a little trouble' (scores 3-5)	6	5.4	4	5.1	2	5.9	
<b>Worst pain</b>							
No pain (score 1)	12	10.6	8	10.1	4	11.8	0.23
Little/moderate pain (scores 2-4)	75	66.4	50	63.3	25	73.5	
Severe pain (scores 5-7)	26	23.0	21	26.6	5	14.7	
<b>Average pain</b>							
No pain (score 1)	27	23.9	18	22.8	9	26.5	0.52
Little/moderate pain (scores 2-4)	80	70.8	56	70.9	24	70.6	
Severe pain (scores 5-7)	6	5.3	5	6.3	1	2.9	

<sup>#</sup>Column percentages reported. Percentage totals may not add up to 100% because percentages were rounded to the nearest tenth decimal place.

<sup>x</sup>Data missing for one subject.

<sup>†</sup>P values based on Cochran-Mantel-Haenszel row mean score statistics, \*Significant at P<0.05.

## Figures

Figure 1. Flow diagram of study participants enrolled with mild symptoms of pericoronitis.

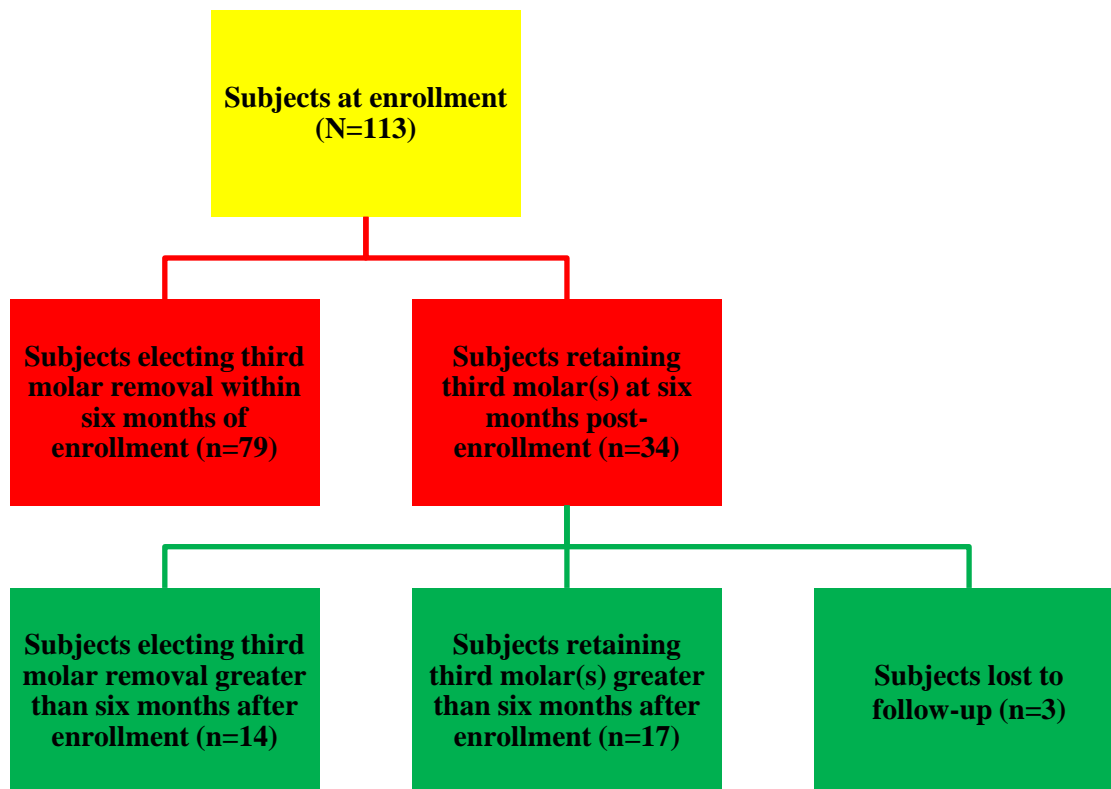
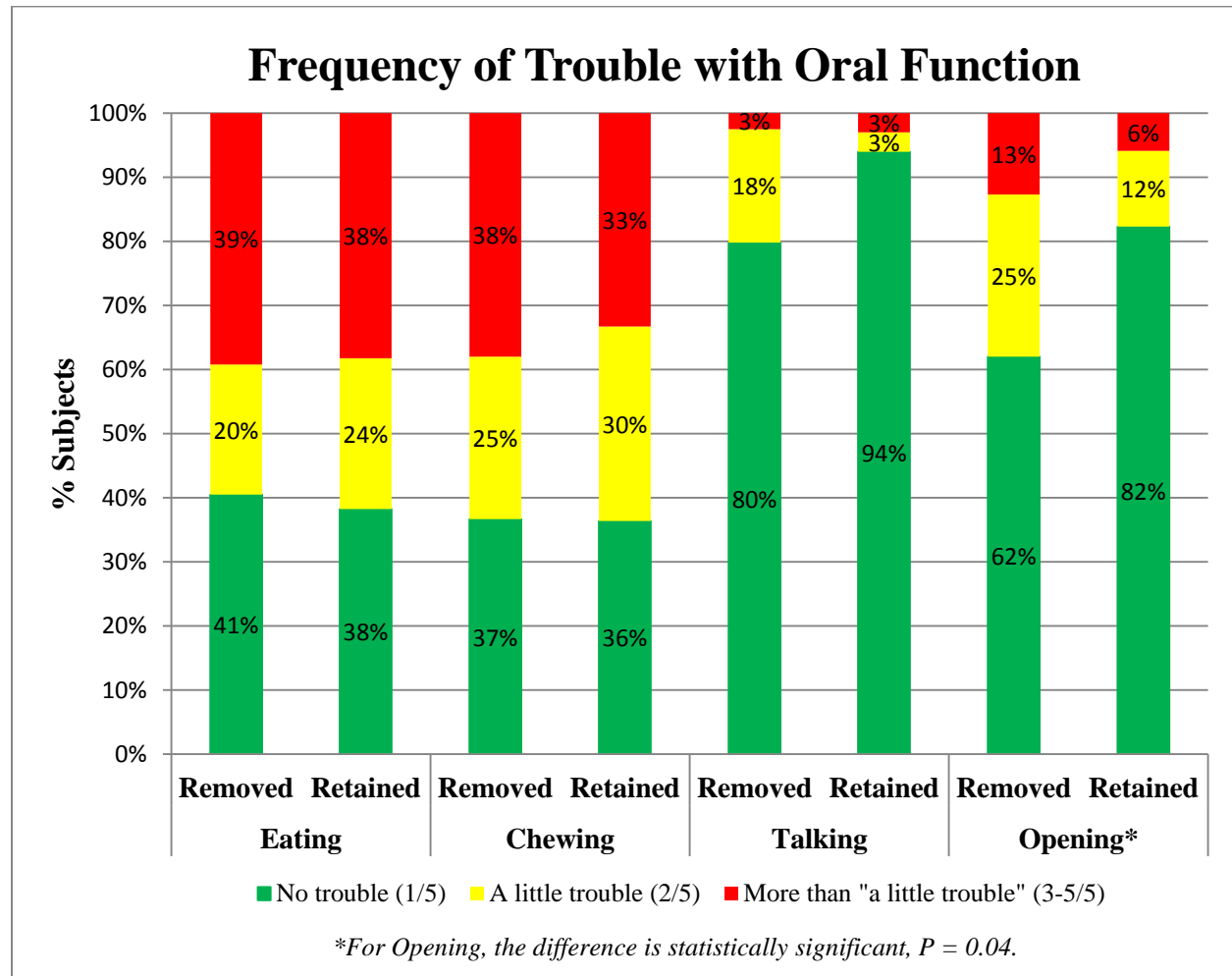


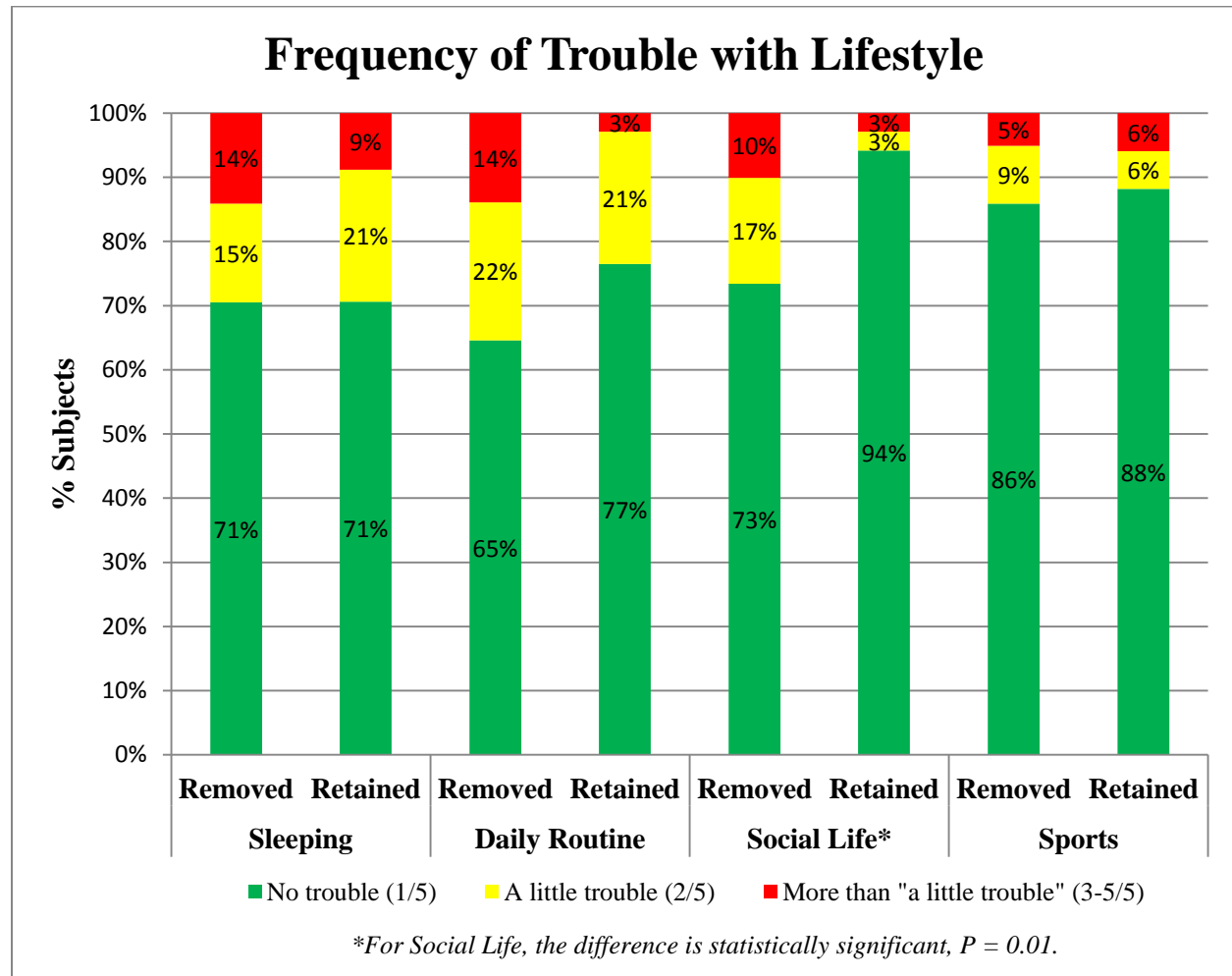
Figure 2. Comparison of the distribution of subjects reporting difficulty with oral function in the week prior to enrollment for the Removed (n=79) and Retained (n=34) groups.



\*P value based on Cochran-Mantel-Haenszel row mean score statistics.

*Note:* The **Removed** group consisted of subjects who elected third molar removal within six months of enrollment. The **Retained** group consisted of subjects who retained their third molars at six months post-enrollment. Percentage totals may not add up to 100% because percentages were rounded to the nearest whole number.

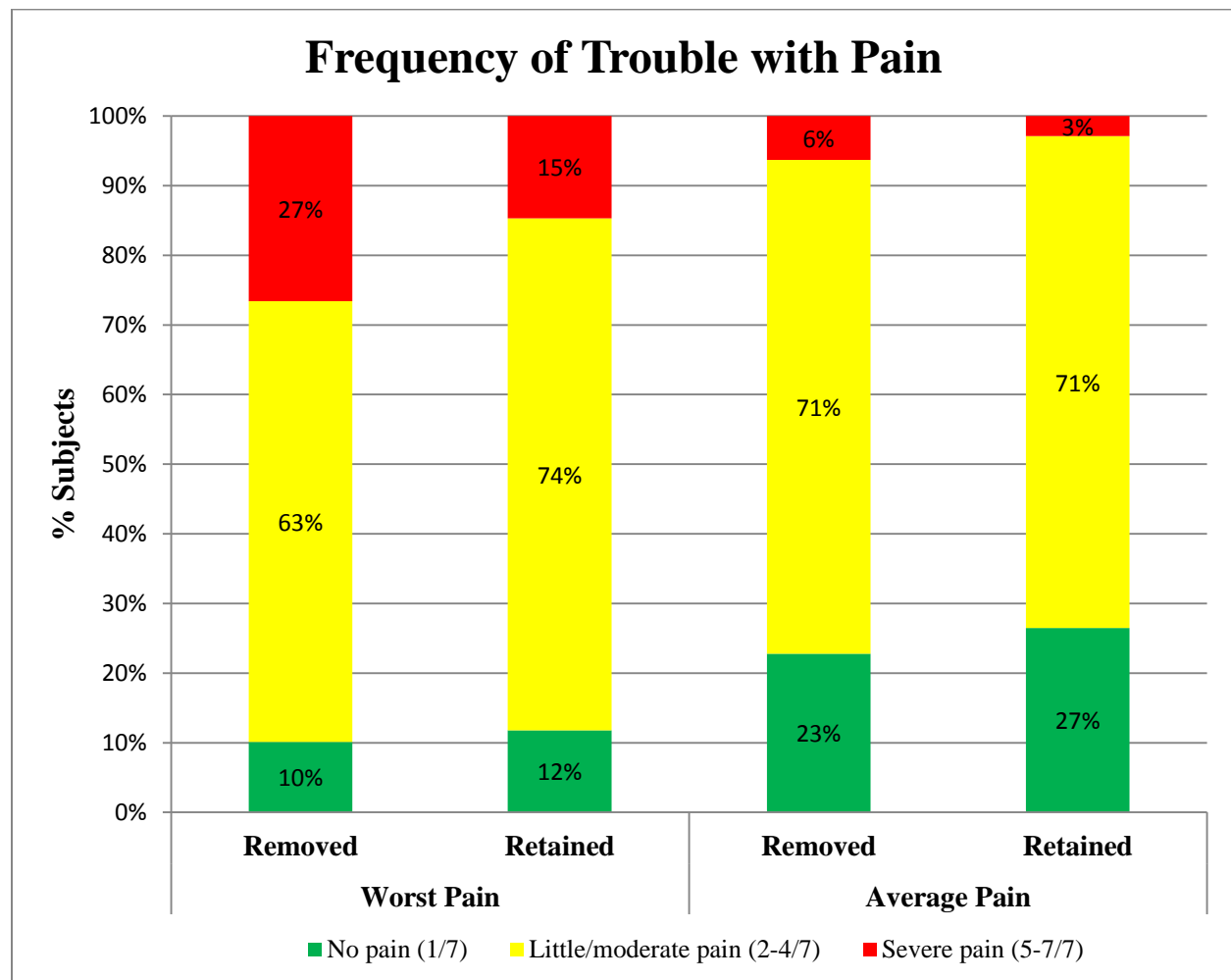
Figure 3. Comparison of the distribution of subjects reporting difficulty with lifestyle in the week prior to enrollment for the Removed (n=79) and Retained (n=34) groups.



\*P value based on Cochran-Mantel-Haenszel row mean score statistics.

*Note:* The **Removed** group consisted of subjects who elected third molar removal within six months of enrollment. The **Retained** group consisted of subjects who retained their third molars at six months post-enrollment. Percentage totals may not add up to 100% because percentages were rounded to the nearest whole number.

Figure 4. Comparison of the distribution of subjects reporting pain in the week prior to enrollment for the Removed (n=79) and Retained (n=34) groups.



*Note:* The **Removed** group consisted of subjects who elected third molar removal within six months of enrollment. The **Retained** group consisted of subjects who retained their third molars at six months post-enrollment. Percentage totals may not add up to 100% because percentages were rounded to the nearest whole number.



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